

**Amendments to the Claims:**

This listing of claims will replace all prior versions and listings of claims in the application:

**Listing of Claims:**

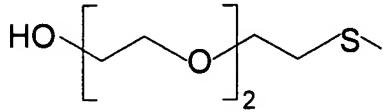
Claims 1-94 (Canceled)

Claim 95 (New): A quantum dot, comprising:

    a nanocrystalline core exhibiting quantum confinement and having a band gap;  
    a luminescence promoter linked to the surface of the nanocrystalline core;  
    a non-zinc linking group;  
    an ethylene glycol unit linked to the surface of the nanocrystalline core through  
    the linking group; and  
    the luminescence promoter selected from the group consisting of an ethylene  
    glycol unit, an alkylthio acid, mercaptoacetic acid, and any combination.

Claim 96 (New): The quantum dot of claim 95, wherein the linking group does not  
comprise a group VA or VIA element which is present in the nanocrystalline core.

Claim 97 (New): The quantum dot of claim 95, comprising a group of formula XI,  
comprising a sulfur atom, wherein the sulfur atom is linked to the surface of the  
nanocrystalline core.



XI

Claim 98 (New): The quantum dot of claim 95, wherein the nanocrystalline core comprises cadmium telluride.

Claim 99 (New): A quantum dot, comprising:

- a nanocrystalline core exhibiting quantum confinement and having a band gap;
- a luminescence promoter linked to the surface of the nanocrystalline core; and
- a biofunctional group linked to the surface of the nanocrystalline core,

wherein the luminescence promoter does not comprise a mercaptoalkanoic acid.

Claim 100 (New): A quantum dot, comprising:

- a nanocrystalline core exhibiting quantum confinement and having a band gap;
- a luminescence promoter linked to the surface of the nanocrystalline core;
- a non-zinc linking group; and
- a biofunctional group linked to the surface of the nanocrystalline core through the linking group,

wherein the luminescence promoter is selected from the group consisting of an ethylene glycol unit, an alkylthio acid, mercaptoacetic acid, and any combination.

Claim 101 (New): The quantum dot of claim 100, wherein the quantum dot is stable in aqueous solution under storage in the dark at 4 °C for at least 4 months with respect to luminescence, precipitation, flocculation, and leaching of the biofunctional group.

Claim 102 (New): The quantum dot of claim 100,

- wherein the luminescence promoter is a mercaptoalkanoic acid,
- wherein the mercaptoalkanoic acid is not linked to the surface of the nanocrystalline core through a zinc atom, and
- wherein the biofunctional group is not linked to the surface of the nanocrystalline core through a zinc atom.

**Claim** 103 (New): The quantum dot of claim 100, wherein

the luminescence promoter is mercaptoalkanoic acid,  
the mercaptoalkanoic acid is not linked to the surface of the nanocrystalline core  
through a group VA or VIA element which is present in the nanocrystalline core, and  
the biofunctional group is not linked to the surface of the nanocrystalline core  
through a group VA or VIA element which is present in the nanocrystalline core.

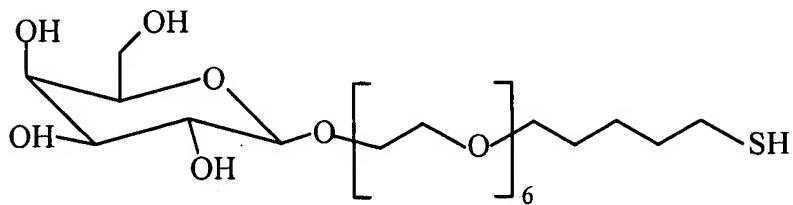
**Claim 104 (New):** The quantum dot of claim 100, wherein the luminescence promoter  
comprises a non-zinc linking group and an ethylene glycol unit linked to the surface of  
the nanocrystalline core through the linking group.

**Claim 105 (New):** The quantum dot of claim 100, wherein the linking group does not  
comprise a group VA or VIA element which is present in the nanocrystalline core.

**Claim 106 (New):** The quantum dot of claim 100, further comprising a substantially  
zinc-free shell layer overcoating the nanocrystalline core.

**Claim 107 (New):** The quantum dot of claim 106,  
the shell layer comprising cadmium sulfide and/or mercury sulfide; and  
the nanocrystalline core comprising a material selected from the group consisting  
of cadmium telluride, cadmium selenide, mercury telluride, mercury selenide, and/or any  
combination of these.

**Claim 108 (New):** The quantum dot of claim 106,  
comprising a group of formula XXX, comprising a sulfur atom,  
wherein the sulfur atom is linked to the surface of the nanocrystalline core,  
wherein the shell layer comprises mercury sulfide, and  
wherein the nanocrystalline core comprises mercury telluride and/or mercury  
selenide.



XXX

Claim 109 (New): The quantum dot of claim 100, wherein the biofunctional group comprises at least one biofunctional unit which is not a peptide.

Claim 110 (New): The quantum dot of claim 100, the biofunctional group comprising a biofunctional unit selected from the group consisting of a monosaccharide unit, a mononucleoside unit, a mononucleotide unit, a monopeptide unit, a glycopeptide unit, and any combination of these.

Claim 111 (New): The quantum dot of claim 100, the biofunctional group comprising a biofunctional unit comprising a lipid unit and/or a glycolipid unit.

Claim 112 (New): The quantum dot of claim 110, the biofunctional group not comprising mannose or dextran.

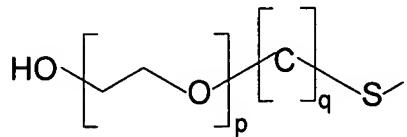
Claim 113 (New): The quantum dot of claim 100, the biofunctional group comprising at least one tumor-associated carbohydrate.

Claim 114 (New): The quantum dot of claim 100, wherein the biofunctional group comprises a Thomsen-Friedenreich disaccharide.

Claim 115 (New): The quantum dot of claim 114, that selectively complexes to endothelial cells.

Claim 116 (New): The quantum dot of claim 114, that is substantially retained by agarose-bound galactose specific peanut agglutinin and that is not substantially retained by agarose-bound mannose/glucose-specific *Pisum sativum* agglutinin.

Claim 117 (New): The quantum dot of claim 100, comprising an ethylene glycol thiol of formula XIII comprising a sulfur atom,



wherein the sulfur atom is linked to the surface of the nanocrystalline core, p is a positive integer, and q is an integer of at least two.

Claim 118 (New): The quantum dot of claim 104, comprising a branched linked chain comprising the ethylene glycol unit.

Claim 119 (New): The quantum dot of claim 100, comprising a carboxylic acid unit linked to the surface of the nanocrystalline core.

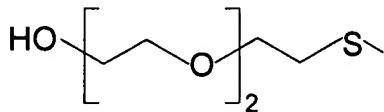
Claim 120 (New): The quantum dot of claim 100, comprising:

an ethylene-glycol-containing linked chain; and  
a biofunctional-group-containing linked chain,  
wherein the ethylene-glycol-containing linked chain does not comprise a  
biofunctional group and  
wherein the biofunctional-group-containing linked chain does not comprise an  
ethylene glycol unit.

Claim 121 (New): The quantum dot of claim 120, wherein the ethylene-glycol-containing linked chain comprises from 3 to 6 ethylene glycol units.

Claim 122 (New): The quantum dot of claim 100, comprising:

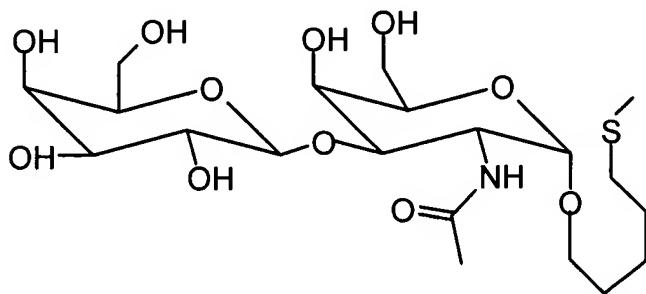
an ethylene-glycol-containing linked chain of formula XI, the sulfur atom of the ethylene-glycol-containing linked chain of formula XI linked to the surface of the nanocrystalline core; and



XI

a biofunctional-group-containing linked chain of formula XXVIIa, comprising a Thomsen-Friedenreich disaccharide as the biofunctional group and five carbon atoms and a sulfur atom,

wherein the sulfur atom of the biofunctional-group-containing linked chain of formula XXVIIa is linked to the surface of the nanocrystalline core.



XXVIIa

Claim 123 (New): The quantum dot of claim 100, comprising:

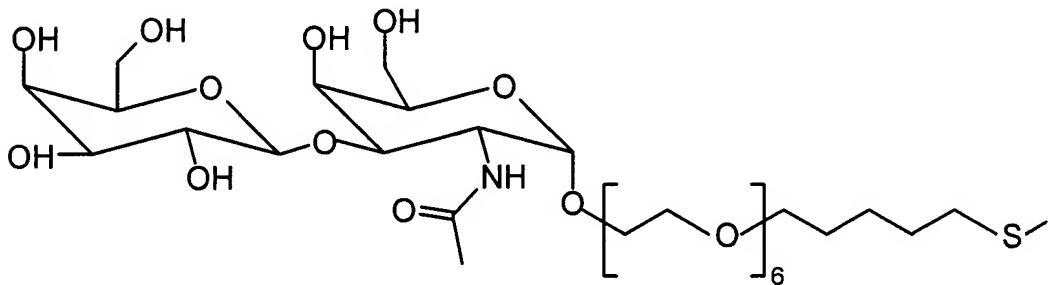
a biofunctional-group-containing linked chain, wherein

an ethylene glycol unit is part of the biofunctional-group-containing linked chain

and

the biofunctional group is part of the biofunctional-group-containing linked chain.

**Claim 124 (New):** The quantum dot of claim 100, further comprising a biofunctional-group-containing linked chain of formula XXVIIb, comprising a Thomsen-Friedenreich disaccharide as the biofunctional group and comprising six ethylene glycol units, five carbon atoms, and a sulfur atom, wherein the sulfur atom of the biofunctional-group-containing linked chain of formula XXVIIb is linked to the surface of the nanocrystalline core.



XXVIIb

**Claim 125 (New):** A formulation comprising:

a liquid; and  
the quantum dot of claim 100,  
wherein the quantum dot is dissolved or suspended in the liquid.

**Claim 126 (New):** The quantum dot of claim 100, that is stable in aqueous solution under storage at room temperature in ambient lighting for at least 4 months with respect to luminescence, precipitation, and flocculation.

**Claim 127 (New):** A method of imaging, comprising:

providing the quantum dot of claim 100;  
contacting the quantum dot with a biological material;  
exposing the biological material to light having a wavelength effective to cause

the quantum dot to luminesce; and

imaging the luminescing quantum dots.

**Claim 128 (New):** The method of claim 127, wherein the biofunctional group exhibits high affinity to tissue in a diseased or abnormal state, and the quantum dot luminescence images the tissue.

**Claim 129 (New):** The method of claim 128, the diseased or abnormal state being cancerous.

**Claim 130 (New):** A method of therapy, comprising:

providing the quantum dot of claim 100; and

contacting the quantum dot with a biological material and thereby treating a disease.

**Claim 131 (New):** The method of claim 100, the biofunctional group comprising an immune-response stimulating group.

**Claim 132 (New):** The method of claim 100, the biofunctional group comprising a tumor-associated antigen.

**Claim 133 (New):** The method of claim 100, wherein the quantum dot further comprises a therapeutic agent linked to the surface of the nanocrystalline core.

**Claim 134 (New):** The method of claim 100, wherein a shell layer and/or the nanocrystalline core comprises a therapeutic agent.

**Claim 135 (New):** A quantum dot coated device, comprising the quantum dot of claim 100 linked to the surface of the device to form a coating on the device.

Claim 136 (New): A cell-quantum dot complex, comprising:

a cell; and

the quantum dot of claim 100,

wherein the biofunctional group is complexed with the cell.

Claim 137 (New): A method for producing a quantum dot, comprising:

providing a luminescence promoter;

refluxing the luminescence promoter with a group IIB element salt, a hydrogen-alkali-group VIA element compound, and a suitable solvent to produce a quantum dot in a solution,

wherein the luminescence promoter is selected from the group consisting of an ethylene glycol unit, an ethylene glycol thiol, an alkylthio acid, mercaptoacetic acid, and any combination of these.

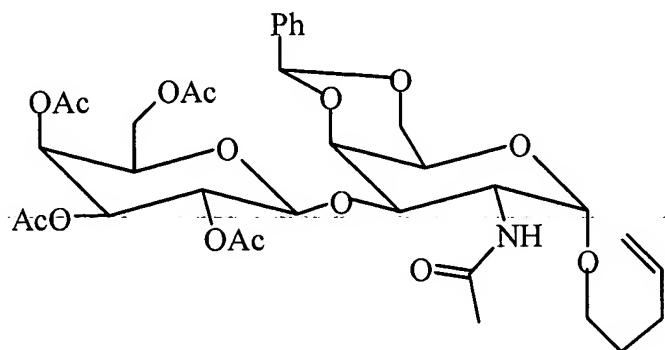
Claim 138 (New): The method of claim 137, comprising:

providing a biofunctional group-thiol, comprising a biofunctional unit; and

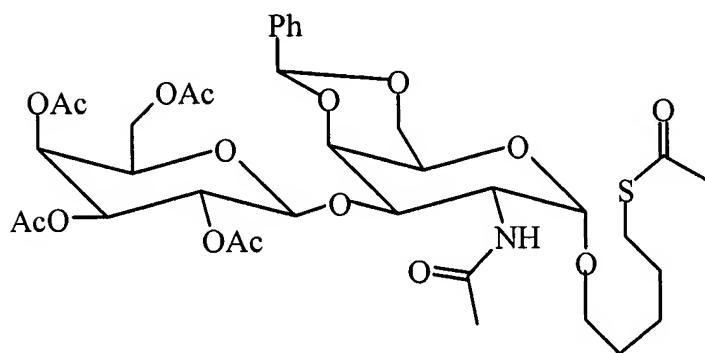
refluxing the biofunctional group-thiol and the luminescence promoter with a group IIB element salt, a hydrogen-alkali-group VIA element compound, and a suitable solvent to produce a quantum dot in a solution.

Claim 139 (New): The method of claim 138, comprising:

reacting a glycoside of formula IV with an alkylthio acid in the presence of 2,2'-azobisisobutyronitrile in 1,4-dioxane at about 75 °C to produce a thioester of formula V;

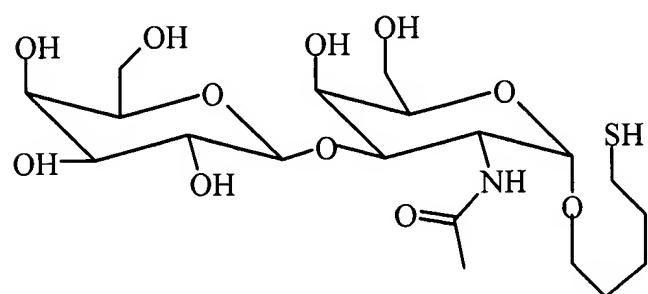


IV



V

debenzylidinating the thioester of formula V;  
 hydrolyzing the debenzylidinated thioester of formula V to produce a Thomsen-Friedenreich-thiol of formula VI; and



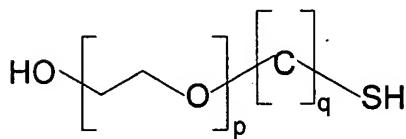
VI

refluxing the Thomsen-Friedenreich-thiol of formula VI with cadmium

perchlorate, a luminescence promoter, hydrogen sodium telluride, and a suitable solvent, to produce a Thomsen-Friedenreich-functionalized quantum dot in a solution, wherein the suitable solvent comprises water and/or N,N-dimethylformamide.

Claim 140 (New): The method of claim 137,

wherein the luminescence promoter comprises an ethylene glycol thiol, wherein the ethylene glycol thiol is of formula XIII, and



XIII

wherein p is a positive integer and q is an integer of at least two.

Claim 141 (New): The method of claim 137,

wherein the group IIB element salt is cadmium perchlorate and

wherein the hydrogen-alkali-group VIA element compound is hydrogen sodium telluride.

Claim 142 (New): The method of claim 137, wherein the suitable solvent comprises water and/or N,N-dimethylformamide.

Claim 143 (New): The method of claim 138, further comprising:

reacting a glycoside of formula XVIII with an alkylthio acid in the presence of a catalyst to produce an acetylated, benzylidenated biofunctional group thiol of formula XIX;

Acetylated, Benzylidenated Biofunctional Group  $\text{--R}_{12}\text{--}$

XVIII



XIX

debenzylidenating the thioester of formula XIX; and  
 hydrolyzing the thioester of formula XIX to produce the biofunctional group-thiol of formula XVb,

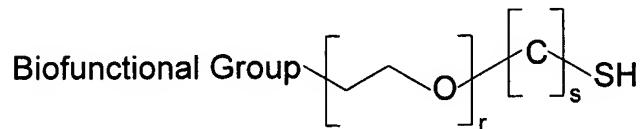


XVb

wherein R<sub>12</sub> comprises a carbon atom and R<sub>13</sub> comprises a carbon atom.

Claim 144 (New): The method of claim 138,

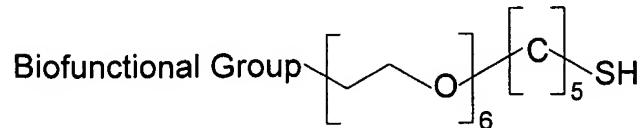
wherein the biofunctional group-thiol comprises a thiol of formula XVIb and



XVIb

wherein r is a positive integer and s is an integer of at least two.

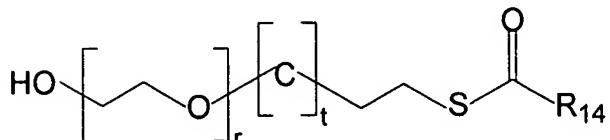
Claim 145 (New): The method of claim 144, wherein the biofunctional group-thiol comprises a thiol of formula XVIIb.



XVIIb

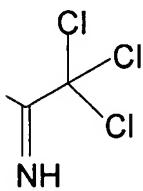
Claim 146 (New): The method of claim 144, further comprising:

reacting a compound comprising ethylene glycol of formula XXb



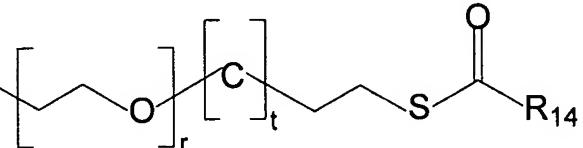
XXb

with a glycoside having azide and a group of formula XXbb as pendant groups and quenching the reaction with triethylamine to produce a compound of formula XXIIIb;



XXbb

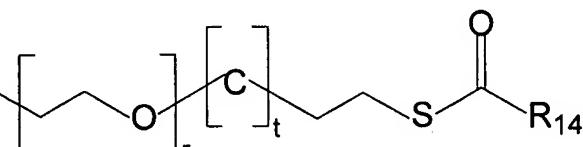
Acetylated, Benzylidenede,  
Azide-Functionalized  
Biofunctional Group



XXIIIb

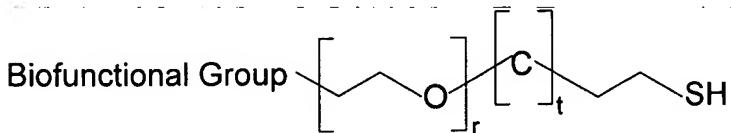
treating the compound of formula XXIIIb with acetic anhydride and a reducing agent to produce a compound of formula XXIIIc in which the azide group of formula XXIIIb is replaced with an acetamido group;

Acetylated, Benzylidenede,  
Biofunctional Group



XXIIIc

debenzylidenating the compound of formula XXIIIC; and  
hydrolyzing the compound of formula XXIIIC to produce the biofunctional-group  
thiol of formula XXIVb,



XXIVb

wherein r is a positive integer, t is zero or a positive integer, and R<sub>14</sub> comprises a carbon atom.

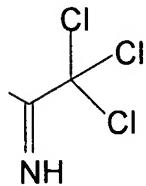
Claim 147 (New): The method of claim 146, wherein the group IIB element salt is cadmium perchlorate,

wherein the hydrogen-alkali-group VIA element compound is hydrogen sodium telluride,

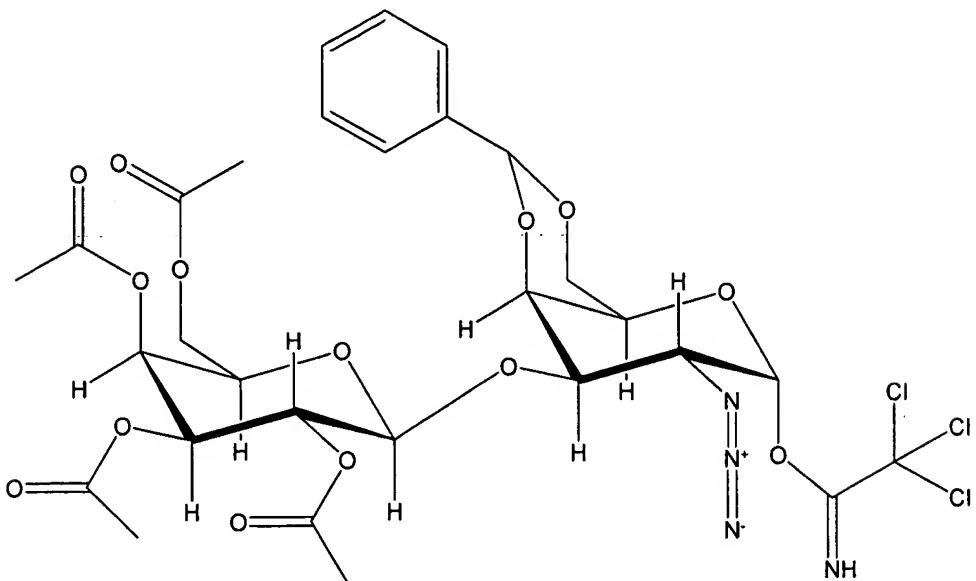
wherein r is six and t is three,

wherein R<sub>14</sub> is methyl,

wherein the glycoside having an azide and a group of formula XXbb as pendant groups has formula XXII,

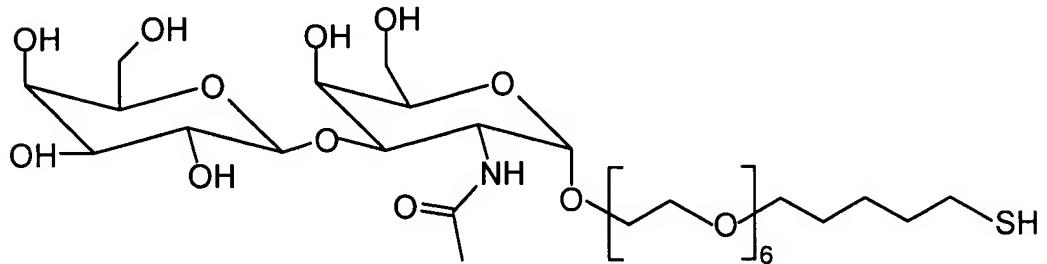


XXbb



XXII

wherein the reducing agent is zinc,  
 wherein the debenzylideneating comprises treatment with acetyl chloride and  
 quenching with pyridine;  
 wherein the hydrolyzing comprises treatment with sodium methoxide and  
 quenching with ion-exchange resin, and  
 wherein the biofunctional-group thiol is of formula XXIVc.

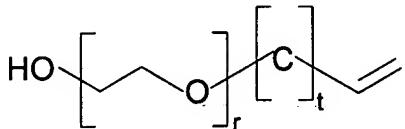


XXIVc

Claim 148 (New): The method of claim 146, further comprising:

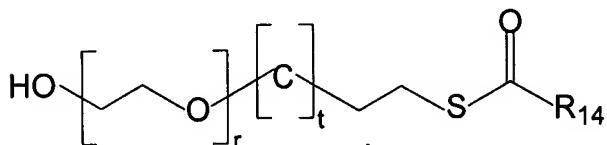
reacting a polyethylene glycol with sodium hydroxide and a brominated alkene to

produce a compound of formula XXa; and



XXa

reacting the compound of formula XXa with an alkylthio acid in the presence of a catalyst to produce a compound of formula XXb,



XXb

wherein r is a positive integer, t is zero or a positive integer, and R<sub>14</sub> comprises a carbon atom.

Claim 149 (New): The method of claim 138, comprising refluxing the biofunctional group-thiol of formula III with a group IIB element salt, a hydrogen-alkali-group VIA element compound, and a suitable solvent to produce a quantum dot in a solution,



III

wherein R<sub>1</sub> comprises a carbon atom and/or an ethylene glycol unit,

wherein the group IIB element comprises cadmium and/or mercury, and

wherein the group VIA element comprises tellurium and/or selenium.